Vanasse Hangen Brustlin, Inc.

Transportation
Land
Development
Environmental
Services

VHB

Kilton Road
Six Bedford Farms, Suite 607
Bedford, New Hampshire
03110-6532
603 644-0888
FAX 603 644-2385

Attendees	Jeff Brillhart, NHDOT Charlie Hood, NHDOT Butch Waidelich, FHWA Bruce Tasker, VHB Marty Kennedy, VHB Tony Grande, VHB Dave Wilcock, VHB Howard Muise, VHB SEE ATTACHED LIST	Date/Time:	February 14, 2001, 4:00 PM
		Project No.:	Salem – Manchester 50885 10418-C
Place:	West Running Brook Middle School, Derry NH	Re:	Resource Agency Meeting #11–I-93, Rationale Report discussion
		Notes taken by:	VHB; Reviewed by Jeff Brillhart

Charlie Hood opened the meeting and discussed the coordination process that is being used to review the I-93 project with the Resource Agencies.

The Resource Agency representatives in attendance then introduced themselves.

Jeff Brillhart explained that the meeting is being held to discuss the *Rationale Report* that was published the week of January 21, 2001. The *Rationale Report* represents the completion of Phase II of the EIS and discusses the efforts that have been completed since the *Scoping Report* was published in May of 2000. The *Rationale Report* includes recommendations as to what constitutes the reasonable range of alternatives to be carried forward for detailed evaluation in the DEIS.

The recommendations included in the *Rationale Report* are recommendations that were presented and discussed as part of a series of Public Informational meetings held within the five corridor communities this past November and December. The recommendations include widening I-93 to 4-lanes in each direction south of Exit 3 and 3-lanes in each direction north of Exit 3 as well as looking at 3-lane and 4-lane alternatives in each direction for the entire corridor. In addition, these alternatives would include constructing or expanding park and ride lots at Exits 2, 3, 4, and 5 and facilitating bus service to Boston and industrial centers in northern Massachusetts, as well as providing room for, and as practical constructing, sub-grade for transit service within the highway corridor.

Transportation Systems Management (TSM) measures, which are minor improvements that can be accomplished within the existing ROW, are also included as part of the *Rationale Report* recommendations.

Marty Kennedy discussed the Level of Service (LOS) evaluations used to assess the various mode combinations considered in the *Rationale Report.*

At the last Resource Agency meeting a question arose regarding the LOS designations shown in the tables for the various mode combinations. At that time Mark Kern suggested that the volume to capacity ratio (v/c) should be added to the LOS table to make it easier to compare the various alternatives. The previous LOS table has been updated with v/c ratios in addition to levels of service letter designation. (A handout was provided)

Marty reviewed the background as to the development of the LOS table.

The criteria used to determine how the operations of I-93 were evaluated were presented several meetings ago. The Department's recommended design criteria for traffic operations is: LOS C is desirable, but LOS D would be acceptable for the 2020-design hour.

Marty noted that the future year volume projections are conservative (on the low side). Given these conservative projections, the operational analysis showed that to achieve a LOS D operation during the peak-hour condition, I-93 would need to be expanded to a 10-lane section (5-lanes in each direction) south of Exit 1; an 8-lane section (4-lanes in each direction) between Exits 1 and 3; and a 6-lane section (3-lanes in each direction) north of Exit 3. The next step of the analysis considered other modes of transportation (ways to get people out of their cars) to reduce the peak hour volume of traffic on I-93 and hopefully reduce the need to widen the highway. Marty reminded the agencies that over the last few meetings, Howard Muise had discussed the ridership projections for a number of alternatives that were developed to understand the sensitivity of how various transportation mode options might reduce the number of peak hour vehicles on the highway.

The new handout again shows different combinations of rail, bus and HOV modes in combination with various highway layouts resulting in 14 alternative conditions. For each of the alternatives, the 2020 peak hour ridership resulting from the different combinations of rail, bus and HOV modes was subtracted from the 2020 peak hour traffic projections, and the highway LOS was evaluated to show how the modes might effect the number of lanes needed along I-93. The analysis found that during the design hour (in the Year 2020), the alternative modes result in very little, if any, reduction in traffic. From the standpoint of how much peak hour traffic is reduced by implementing the various mode combinations, the analysis found that the alternative modes did not remove enough traffic to have an effect on reducing the number of lanes needed to maintain LOS D along the highway. The primary reason for this, as discussed in previous meetings, is that the congestion along I-93, even today, occurs not in a single hour, but extends over a peak-period of approximately 3 hours in the morning and 3 hours in the evening. The alternative modes provide for some reduction in traffic, but these reductions occur during the outside hours (shoulder hours) of the morning or evening 3-hour period. The ridership realized from the implementation of the alternative modes does not have an effect on reducing the design hour volume but does have some effect on the hours before and after the peak hour. It was for that reason that the shoulder hours were evaluated to understand what is happening in the hour before and hour after the design hour. The shoulder hour volumes will be reduced with the implementation of the other mode options and if the ridership and resultant volume reduction is great enough, the LOS for the shoulder hour may improve. Looking at the LOS for the design hour along the corridor did not provide sensitivity as to how alternative modes of transportation might help reduce highway congestion. A comparison of the shoulder hour LOS would provide a measure to gauge the merits of a particular combination of modes and thus help in comparing the various mode combinations. The table provided is a summary of those 3-hour period comparisons. With the exception of the added v/c ratio, the table is essentially the same as presented at previous meetings. The left side of the table lists the 14 alternatives or mode combinations while the columns basically provide each of the segments along I-93 between the interchanges. Within each of the segments, there are separate columns for the LOS for the design hour volume and the shoulder hour volume to which the v/c ratio was added. The volume to capacity ratio is the volume along that segment compared to the

capacity of the segment. A v/c of 1.0, indicates that the segment is at capacity, while a v/c of 0.92, means the segment is at 92% of the capacity.

Ken Kettenring:	When you look at capacity, you can't have more than 1.0 for a v/c ratio, is this correct?
Marty Kennedy:	This is true. In some cases we talk of projected volume as compared to existing capacity. In that case we might say, in the future the volume to capacity ratio is 1.5, which means the demand is 50% above and beyond actual capacity. However, for the purpose of our table, when you see a v/c of 1.0, it means the road is at capacity and the volume beyond the capacity threshold spills into the next hour. For example, looking at Alternative 1, south of Exit 1, the LOS is F, and the volume to capacity ratio is 1.0 during the design hour. In addition the volume is so high relative to capacity, that even in the hour before and the hour after the volume to capacity is still at 1.0. Looking at the v/c ratio does in fact help in comparing the alternatives. When using this table, the best way to look at comparisons between the various mode combinations is to concentrate on the segments between Exit 1 and Exit 2, and Exit 2 and Exit 3. (This is because the segment south of Exit 1 needs a 10-lane segment and the NHDOT has stated that it does not plan on constructing a 10-lane section unless Massachusetts constructs 10-lanes. The 8-lane section proposed by the NHDOT as a maximum does not provide enough capacity to meet the minimum LOS D and therefore south of Exit 1, none of these mode combinations really work. Mode combination 10 south of Exit 1 has the best LOS of all mode combinations, but even it has a LOS E operation.) Between Exits 2 and 3, and Exits 3 and 4 there are differences between the peak hour and the shoulder hour LOS which provide some indication as to which mode combinations function better than others.

Questions on this topic:

Bill Neidermeyer:	Can Alternative 10 through Exit 3 which shows a LOS D and then be combined with Alternative 6 from Exit 3 north to compare a 4-lane section transitioning to a 3-lane section?
Marty Kennedy:	Yes. The tables can be used in that fashion.
Rosemary Monahan:	I think that congestion on the highway is underestimated. The growth rate shown in the *Rationale Report* is 1 to 1.5 %, while the historical rate is nearer 5%.
Marty Kennedy:	The growth rate was developed using a traffic model that looked at land use projections. The model indicates that traffic growth in different areas will range between 1 and 1 ½ %. Based on historical growth rates the projections are on the low side. However, if the traffic volume projections were higher, then presumably more lanes would be under discussion. It appears fair to say that the Department is not trying to overbuild the highway. The hope is to build the minimal number of lanes needed, but not more.
Question:	How realistic is it to use the median area that is proposed to be preserved for future rail to be used for bus service?
Butch Waidelich:	One problem would be where to provide for the buses once the construction of the rail begins.

Dave Wilcock:	With regards to using the area being preserved for rail as a bus-way, it may be possible to minimize impacts to operating bus service by locating the bus-way off to one side initially until the rail is needed. Then the rail could be constructed one half at a time to get the rail operational. Once one track of rail is operational, the buses could be eliminated from the corridor and the second half of the rail could be constructed.
Lee Komornick:	Is the State looking at a state wide transit plan?
Jeff Brillhart:	The Department will be contracting with a consultant in the near future (if it hasn't already done so) to catalogue and evaluate bus and park and ride operations and needs.
Dave Wilcock:	The Department is also working on an updated Statewide Rail Plan. This plan is focused on freight rail transportation in NH. A prioritized program of infrastructure improvements is being developed as part of this study. The plan will include recommendations for further study of passenger and commuter rail initiatives across the state. Current initiatives include Lowell-Nashua, I-93, Haverhill-Plaistow, Portsmouth-Kittery, and the high-speed rail option between Montreal and Boston, which would run through Concord and Manchester.
Ken Kettenring:	A concurrent rail study needs to be undertaken and it should begin now and certainly no later than next year.
Jeff Brillhart:	A separate transit study for the region served by I-93 has merit particularly given that beyond the year 2020 the highway widening will be reaching capacity. When that study begins and how it is funded, still needs to be resolved.
Butch Waidelich:	The issue of a concurrent rail study has been discussed on several occasions. At the Environmental Streamlining Board meeting on January 17 the issue was supposed to have been discussed, but wasn't. But, at that meeting, a Dispute Resolution Process was discussed and if agencies feel strongly about a rail study, they need to bring it up through that process.
Jeff Brillhart:	It was listed as an issue to be elevated at the January 17 meeting. The Department's Assistant Commissioner is available to discuss it.
Ken Kettenring:	Bob Varney from NHDES was prepared to discuss this issue at the last Board of Directors meeting. Bob continues to be concerned about this issue.
Rosemary Monahan:	What is Massachusetts doing with their I-93 study?
Howard Muise:	The Massachusetts study has just started. The alternatives are not fully defined yet, but in terms of widening they are looking at widening the existing 3 lanes to 4 lanes. Such improvements would involve reconstructing the peak period shoulder lane to a fourth lane in each direction. The study is also looking at an HOV facility, a rail facility in the corridor and the rail line from Haverhill through Lawrence to North Station in Boston. The study very much is parallel to the NH study, but not as in depth.
Jeff Brillhart:	I have attended (and will continue to do so) meetings with the Merrimack Valley Planning Commission and discussed project elements pertinent to both states. Massachusetts Officials appear to be very interested in and sympathetic to what the Department is trying to do.
Mike Fitzgerald:	Does the traffic model reflect the latest growth trends? I noticed that when the latest census data came out, NH was one of the fastest growing areas in the country. I think the population growth was

	25%. Historically NH land use increases with increases in population so wouldn't that kind of information influence the model?
Marty Kennedy:	The traffic model was developed by the Department and as I understand the model, the model uses assumptions on land use projections based on input from the Regional Planning Commissions (RPC). I am not sure if census data is directly used in the model projections, but I don't believe so.
Mike Fitzgerald:	The 1.5% projection appears to be too low based on historical growth. The Office of State Planning (OSP) has growth data, and the OSP makes projections each year as to how the state will grow.
Moni Sharma:	Page 46 of the *Rationale Report* has an explanation that would help to understand the basis of the traffic model.
Comment:	Do the traffic projections take into account the Manchester Airport expansion?
Jeff Brillhart:	The airport expansion is considered in the traffic model as a traffic generator.
Roberta Robie:	The 4-lane alternative should be extended for the length of the project. Today people are using the Exit 3 interchange to avoid congestion problems at Exit 4. It would be a mistake to have the four lanes ending at Exit 3. The study addresses commuter traffic problems, but the holidays, weekends and special events like the auto races or motorcycle weekend also create traffic problems along I-93 that extend the length of the corridor. On the issue of population there has been a large influx of people. The population is going to continue to increase, in part due to more multi-family housing. Again 4-lanes along the entire corridor makes sense. Are the Resource Agencies proposing a rail study be done in conjunction with the I-93 study with the idea that the rail study would influence the need to widen I-93?
Rosemary Monahan:	Not necessarily, but the issue of rail needs to be addressed and given the lead time needed to implement service, it needs to be addressed soon. I think that the ridership numbers are underestimated for the rail alternatives, and it would be helpful to have these looked at in more detail.
George Sioras:	In Derry, yearly growth projections are made based on information such as the number of building permits issued each year. OSP inputs this type of data into a formula and predicts what the population will be on a 10, 15 and 20 out year basis.
Bill O'Donnell:	It is unfortunate that there was not more ridership in the HOV lane. When the study began, it seemed that the HOV option had a lot of potential. HOV seemingly would have more potential than rail because of the flexibility that the buses and carpools allow. Also it is something that could be implemented right away without a major infrastructure investment. Would the NHDOT design accommodate the HOV in the future if Massachusetts were to provide an extension of their HOV lane further to the north?
Jeff Brillhart:	The HOV option could be revisited depending on what Massachusetts might do. The problem is that the ridership just barely enough in terms of HOV for I-93 south of Exit 1 in NH. To extend the HOV all the way to Exit 3 would be even more difficult because of the lack of ridership. The layouts for widening the highway will retain enough flexibility should HOV lanes be constructed in Massachusetts and extended to the NH border.

Ken Kettenring:	The implementation of an HOV lane was discussed at the last meeting. The discussion noted that if Massachusetts were that to build an HOV lane further to the north, traffic in that lane might increase to the point where the HOV lane to the south would break down.
Howard Muise:	This issue as discussed at a previous meeting deals with the HOV facility going into downtown Boston, and extending that lane to the north may overtax the lane. What the NH I-93 study looked at was an HOV facility coming from NH and extending down into Massachusetts, perhaps as far as MA 128. The feasibility and benefits of constructing an HOV in MA, (i.e. infrastructure and impacts) will be looked at in the Andover area and possibly down to MA 128.
Linda Wilson:	It appears that this process will only take us through another 20 years. We will spend a lot of money to widen I-93, and twenty years from now, we will be exactly where we are now, but the backup will be longer and begin at Exit 3 instead of Exit 1.
Marty Kennedy:	It is not quite that bleak. For example, the 4 -lane section between Exits 1 & 3 would operate at LOS D for the 20-year projections. That is a substantial improvement as compared to the LOS F that exists today. That improvement will carry us over an extended period of time beyond the 2020 design year until the congestion returns to what it is today.
Comment:	Providing a widening of I-93 NB from the border will definitely provide some relief to congestion in the evening, but the widening of I-93 SB to the border will still not reduce the congestion and backup at the border which occurs today. Massachusetts already has a 4-lane section when it uses the breakdown lane as a travel lane and the traffic still backs up. Widening I –93 SB will just get the New Hampshire SB traffic to the MA bottleneck faster. Do we know what MA will do?
Jeff Brillhart:	The Department is coordinating with Massachusetts and will continue to explore solutions jointly.
Roberta Robie:	We have always been talking about widening the highway from south to north, does it make sense to widen north to south?
Jeff Brillhart:	We have not determined how the construction will be phased. Once we have a better idea as to the solution, we can focus on how it will get built.
Tom Irwin:	The Department mentioned that there is a formal comment period for the *Rationale Report, w*hen is the deadline?
Jeff Brillhart:	The deadline (March 1) for this document is informal and is for the Resource Agencies. The *Rationale Report* is not a formal requirement, but it does allows us to document what has been done to date and get feed back on the recommendations.
Tom Irwin:	What do the "auto preference" factors refer to in the ridership model?
Howard Muise:	An analysis of the existing bus ridership was conducted to get a base calibration for the model. After adjustment of a number of factors, the auto preference factor was developed to assist in calibration of the model to better reflect the existing bus ridership.
Lee Komornick:	Are TDM measures (measures that attempt to reduce demand on the highway) required for this project as they were for the Windham – Salem NH 111 project?

Jeff Brillhart: I don't know what the requirements are today relative to TDM measures vis-a-vis increasing highway capacity. A variety of TDM measures are being considered for the project, such as, increasing the number of park and ride lots and providing more bus service.

Bill O' Donnell: The requirements at the time of the Windham –Salem study were a part of the air quality regulations. I am not sure how that is looked at today.

Cliff Sinnott: For the Windham-Salem project, the question of adding additional capacity came into play because the project was in a severe non-attainment area relative to air quality. If capacity was added to a highway, the idea was to try and offset that capacity with some type of TDM measures. I think this became mute with the 1996 CAA amendment.

Jeff Brillhart: Initiatives that have been going forward since the last meeting.

- NHDOT and the various Resource Agencies including the EPA, DES, FHA, ACOE are working with Parsons Brinkerhoff to identify what the secondary impacts might be as a result of widening the I-93 corridor. It appears that the DELPHI process will be used. This process involves providing a panel of experts with corridor background data on land use, population growth, etc., and then asking the panel a number of questions related to how the region served by the corridor will develop. This information is then summarized and used to determine how this growth will affect the regions resources.
- The Department is going to take a hard look at a bike trail along the entire length of the project corridor.
- Detailed concepts showing slope lines and approximate resource and right of way impacts for the widening alternatives are being developed and will be available at subsequent meetings.
- Coordination with the officials in Massachusetts to understand what each state is considering for the I-93 corridor is ongoing.

Moni Sharma: What happens after the DELPHI process has reached its conclusions?

Jeff Brillhart: The process will try and point out which locations would grow in the future and perhaps the type of growth. Using that information the secondary impacts will be quantified.

Butch Waidelich: The EIS will try to disclose the secondary impacts in a reasonable and complete fashion.

Bill O'Donnell: The FHWA feels that the secondary impacts should be identified as part of the project, but the FHWA feels the project should not provide mitigation related to impacts caused by subsequent development. Such impacts should be mitigated by the developer.

Roberta Robie: Relative to the bike trail evaluation, there have been studies done for other projects where the cost of constructing a bike facility outweighs the benefit.

Jeff Brillhart: This issue will be a consideration as the designs are developed.

Cliff Sinnott: The bike study should include consideration for using the Manchester to Lawrence rail corridor as a bike trail.

Jeff Brillhart: The focus will be on the I-93 corridor and enhancing transportation along the corridor.

Jeff Brillhart: In mid March, the 3-lane and the 4-lane detailed concept plans from the state line through Exit 2 will be presented.

LEVEL OF SERVICE (LOS)

LOS A	*Level of Service A* describes free-flow operations. Free-flow speeds prevail. Vehicles are almost completely unimpeded in their ability to maneuver within the traffic stream. Even at the maximum density for LOS A, the average spacing between vehicles is 530 ft, or 26 car lengths, which affords the motorist a high level of physical and psychological comfort. The effects of incidents or point breakdowns are easily absorbed at this level.
LOS B	*Level of Service B* represents reasonably free flow, and free-flow speeds are maintained. The lowest average spacing between vehicles is about 330 ft, or 17 car lengths. The ability to maneuver within the traffic stream is only slightly restricted, and the general level of physical and psychological comfort provided to drivers is still high. The effects of minor incidents and point breakdowns are still easily absorbed.
LOS C	*Level of Service C* provides for flow with speeds at or near the free-flow speed of the freeway. Freedom to maneuver within the traffic stream is noticeably restricted at LOS C, and lane changes require more care and vigilance on the part of the driver. Minimum average spacings are in the range of 220 ft, or 11 car lengths. Minor incidents may still be absorbed, but the local deterioration in service will be substantial. Queues may be expected to form behind any significant blockage.
LOS D	*Level of Service D* is the level at which speeds begin to decline slightly with increasing flows. In this range, density begins to increase somewhat more quickly with increasing flow. Freedom to maneuver within the traffic stream is more noticeably limited, and the driver experiences reduced physical and psychological comfort levels. Even minor incidents can be expected to create queuing, because the traffic stream has little space to absorb disruptions. Minimum average vehicle spacings are about 165 ft, or eight car lengths.
LOS E	At its highest density value, *Level of Service E* describes operation at capacity. Operations at this level are volatile, there being virtually no usable gaps in the traffic stream. Vehicles are spaced at approximately six car lengths, leaving little room to maneuver within the traffic stream at speeds that are still over 49 mph. Any disruption to the traffic stream, such as vehicles entering from a ramp or a vehicle changing lanes, can establish a disruption wave that propagates throughout the upstream traffic flow. At capacity, the traffic stream has no ability to dissipate even the most minor disruptions, and any incident can be expected to produce a serious breakdown with extensive queuing. Maneuverability within the traffic stream is extremely limited, and the level of physical and psychological comfort afforded the driver is poor.
LOS F	*Level of Service F* describes breakdowns in vehicular flow. Such conditions generally exist within queues forming behind breakdown points. Such breakdowns occur for a number of reasons: • Traffic incidents cause a temporary reduction in the capacity of a short segment, so that the number of vehicles arriving at the point is greater than the number of vehicles that can move through it. • Points of recurring congestion exist, such as merge or weaving areas and land drops where the number of vehicles arriving is greater than the number of vehicles discharged. • In forecasting situations, any location where the projected peak-hour (or other) flow rate exceeds the estimated capacity of the location presents a problem. Note that in all cases, breakdown occurs when the ratio of demand to actual capacity or the ratio of forecast demand to estimated capacity exceeds 1.00.

Source: Highway Capacity Manual Special Report 209, 3rd Edition, Transportation Research Board, National Research Council, Washington, D.C. 1998.

2020 Directional Design Hour Volume (DDHV) and Shoulder Hour Level of Service and V/C Summary
for I-93 between I-293 and the Massachusetts State Line
Resulting from Bus, Rail and HOV Lane Improvements

Alternative	South of Exit 1				Exit 1 to Exit 2				Exit 2 to Exit 3				Exit 3 to Exit 4				Exit 4 to Exit 5				North of Exit 5			
	DDHV*		Shoulder Hour***		DDHV		Shoulder Hour		DDHV		Shoulder Hour		DDHV		Shoulder Hour		DDHV		Shoulder Hour		DDHV		Shoulder Hour	
	LOS**	v/c^	LOS	v/c	LOS	v/c	LOS	v/c	LOS	v/c	LOS	v/c	LOS	v/c	LOS	v/c	LOS	v/c	LOS	v/c	LOS	v/c	LOS	v/c
Alt. 1 (No Build w/West Rail)	F	1.00	F	1.00	F	1.00	F	1.00	F	1.00	F	1.00	F	0.94	E	0.85	F	1.00	F	0.97	F	1.00	F	1.00
Alt. 2 (No Build w/Enhanced Rail)	F	1.00	F	1.00	F	1.00	F	1.00	F	1.00	F	1.00	F	0.94	E	0.86	F	1.00	F	0.97	F	1.00	F	1.00
Alt. 3 (No-Build w/Rail)	F	1.00	F	1.00	F	1.00	F	1.00	F	1.00	F	1.00	F	0.90	D	0.74	F	1.00	E	0.89	F	1.00	F	1.00
Alt. 4 (No-Build w/HOV,Bus)	F	1.00	F	0.94	F	1.00	F	1.00	F	1.00	F	1.00	E	0.81	D	0.69	F	0.98	E	0.84	F	1.00	F	0.99
Alt. 5 (No Build w/HOV,Bus,West Rail)	F	1.00	F	0.92	F	1.00	F	1.00	F	1.00	F	1.00	E	0.80	D	0.68	F	0.98	E	0.83	F	1.00	F	0.99
Alt. 6 (3 Lanes w/Bus)	F	1.00	F	1.00	F	0.98	E	0.86	F	0.92	E	0.82	D	0.65	C	0.58	D	0.72	D	0.64	D	0.75	D	0.69
Alt. 7 (3 Lanes w/HOV,Bus)	F	1.00	F	1.00	E	0.89	D	0.76	E	0.84	D	0.73	C	0.57	C	0.50	D	0.67	C	0.59	D	0.72	D	0.66
Alt. 8 (3 Lanes w/Bus, West Rail)	F	1.00	F	1.00	F	0.98	E	0.84	F	0.92	E	0.81	D	0.65	C	0.57	D	0.72	D	0.63	D	0.75	D	0.68
Alt. 9 (3 Lanes w/HOV,Bus,West Rail)	F	1.00	F	0.99	E	0.89	D	0.75	E	0.84	D	0.72	C	0.57	C	0.49	D	0.67	C	0.58	D	0.72	D	0.66
Alt. 10 (4 Lanes w/Bus)	E	0.92	E	0.82	D	0.75	D	0.66	D	0.70	D	0.63	C	0.49	C	0.44	C	0.55	C	0.49	C	0.57	C	0.53
Alt. 11 (2 Lanes w/HOV,Bus,East Rail)	F	1.00	F	0.97	F	1.00	F	1.00	F	1.00	F	1.00	E	0.82	D	0.70	F	0.98	E	0.86	F	1.00	F	0.99
Alt. 12 (3 Lanes w/HOV,Bus,East Rail)	F	1.00	F	1.00	E	0.89	E	0.80	E	0.84	E	0.75	C	0.57	C	0.51	D	0.67	C	0.60	D	0.72	D	0.66
Alt. 13 (2 Lanes w/HOV, Bus, East Rail)	F	1.00	F	1.00	F	1.00	F	1.00	F	1.00	F	1.00	F	0.90	D	0.74	F	1.00	E	0.89	F	1.00	F	1.00
Alt. 14 (3 Lanes w/HOV,Bus,Enhanced Rail)	F	1.00	F	0.97	E	0.87	D	0.73	E	0.84	D	0.70	C	0.56	C	0.47	D	0.67	C	0.57	D	0.72	D	0.66

* DDHV - Directional Design Hour Volume
** LOS - Level of Service (see attached sheet for definition)
*** Shoulder Hour - The hour before and after the design hour
^ v/c - Volume to capacity ratio (volume / 2,200)